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CRITICISMS AND DISCUSSIONS.

THE CONTRARY AND THE CONTRADICTORY IN BIOLOGY: A STUDY OF VITALISM.

The continued and frequent discussion quite recently of the subject of Mechanism and Vitalism indicates that the problems involved, notwithstanding their fundamental theoretical importance for the biological sciences, are either not yet satisfactorily solved, or, as also may well be the case, are misconceived and misstated. This state of affairs is due, we believe, to the fact that purely methodological principles are not taken into sufficient consideration in the attempts to reach a solution. This view is confirmed in the instance of a work before us,¹ where both a clear analysis of the nature and a consistent and systematic treatment of the problem are absent, notwithstanding that much of value is presented. Once prior recognition of the importance for the problem of considering methodological principles is made, the same length of discussion and criticism that are usually connected therewith would not be necessary.

In justification of our statement we find that, for instance, Bütschli, after admitting the existence of no essential difference between neo-vitalism and vitalism, since for him both are characterised by the acceptance of the presence in the organism of a special "prinzip" or "force" or "Geschehensgesetzlichkeit," wholly absent in inorganic things, states that both views also admit the validity of a *causal* (kausal-mechanistisch) construction of life phenomena; for both agree in making "vital force" the *cause* of these phenomena. Accordingly on the basis of fundamental methodological principles we find that, if the presence of this special "causal-acting," "law-following" vital force is the essential and specific attitude of the organism, then vitalism in no way contradicts mechanism (i. e., the theory and laws of energy) or makes impossible the application of its principles to organic phenomena, but on the contrary not only that the two theories are quite compatible and both can be true at the same time, but that vitalism must in fact even be subsumed under mechanism.

The ground for this assertion lies in the general logical doctrine of classification, of which there are two well-known methods, viz., logical and dichotomous, or

¹ *Mechanismus and Vitalismus*, Bütschli, Leipzig. 1901. 104 pp.

disjunctive. According to the former two or more classes are subsumed under a genus as coördinate species upon the basis of certain both common and different (resp., *conferentia* and *differentia*) yet in each case *positively* characterised qualities, giving, according to strict logical terminology, *contraries*; in the second method the differentia of one or more of the coördinate species are determined *negatively* with reference to those of another, forming *contradictories*, of which there can be only two. In this procedure that class or those classes which are characterised *negatively* in the dichotomous division must prior to this be recognised as different from the others upon the basis of *positively* existing attributes, i. e., they must be proven to be really existing classes upon another basis than that of the negation of that of which they are the contradictory. It is evident from this, then, that in each case the classes are subsumable under one and the same genus which is made up of the conferentia that exist side by side with the either positively or negatively presented differentia.

There is a distinction, therefore, between contraries and contradictories; the former affirm the essentiality of definite positive yet different attributes for two or more species; the latter negate this essentiality for one or more classes of attributes which are necessary for another. As examples of the two we have, as contraries, the members of the color series, red, blue, violet, etc., lines straight and curved, showing, as above stated, that they may be many or reduced to two; as contradictories, monovalent and non-monovalent atoms, red and not-red things, straight and not-straight lines, prime and not-prime numbers, *showing that the negative class would, if the positive characterisation were made of it, really include or be identical with one and in some cases many classes, i. e., contraries*. But according to both methods, however, the species are coördinate because of the existence of conferentia, as, in the examples, of valence, color, line, and number; i. e., the contradictory of straight, not-straight, does not include everything except a straight line, as, e. g., Galileo, Sistine Madonna, Arion, Perseus, etc., but only curved lines, which form the contrary.

These principles of method, *first*, that in the case of both contraries and of contradictories conferentia exist which form a genus, so that *genus and species cannot possibly contradict*, and, *second*, that it is *always possible to convert the logical into the dichotomous division* by passing from the positive to the negative determination, *from the contrary to the contradictory, and vice versa*, these principles should be continually borne in mind in the examination of the arguments for a "vital force" and in our own attempt to make clear the nature of the problem of the relation of vitalism to mechanism.

As preliminary to the application of these principles we must, however, establish as clearly and definitely as possible the meanings which, whether from logical necessity or from pure arbitrariness, nevertheless as a matter of fact, attach themselves to the forms we shall use; for *mechanism and vitalism can be contrary to or contradict each other provided only that they are related as coördinates and*

not if the latter is subordinate. Both of these latter relations might, however, exist at the same time were one of the terms ambiguous, having a narrower and a broader meaning, as is to a certain extent the case with mechanism, and could the assumption of a "vital force" be really justified. However, to investigate the grounds which are offered as demanding such an assumption and to show that after all the conclusion from these is an *invalid* immediate inference and so to demonstrate the real nature of the origin of vitalism, this forms a large part of our discussion.

Bütschli does not admit the existence of any ambiguity in the term *mechanism*, but *distinguishes it from mechanics*; the latter is the science of the phenomena of "equilibrium and motion" (p. 7), i. e., kinetic energy; the former is more general; it means to "understand" and "explain" upon the basis of the *necessary* assumption of a *causally* and *uniformly* acting something (*Geschehenswesen*), and he derives from this the adjective *mechanistic*. We are of the opinion that the distinction here made is one not always recognised, and thence comes the possible ambiguity of the term mechanism. However, it corresponds essentially to that made by many recent authors between Energetics on the one hand as genus, and the sciences of the various energies, e. g., Electrodynamics, Thermodynamics, etc., on the other as species, i. e., between the science of the common qualities of all the energies, chemical, "distance," osmotic, kinetic, as genus, and the special sciences of each one of these as species. The *conferentia* of all these specific energies, i. e., of energy, are the *interdependent attributes of regularity and uniformity, causality, conservation, "equalisation of uncompensated potential differences,"*¹ "*shortest time*," "*greatest working*," and, as empirical investigation has shown, *dissipation*, i. e., increase of *entropy*. *Mechanism can be identified with Energetics* in this above meaning and so distinguished from mechanics, and if we do this we have at the same time made clear the logical necessity (*Naturnothwendigkeit*) and justification of accepting the above attributes as making up the meaning of mechanism: for these attributes are, at least some of them, fundamental, ultimate, lying at the basis of and conditioning any science of nature, and without them no "understanding," no "explanation" is possible. Making this identification the result is, in accordance with our methodological principles, that vitalism, if it means the theory of a "vital force," supposing this to be justified, can neither contradict nor be contrary to mechanism, but only to mechanics, the science of the specific energy of moving mass-points, and to the sciences of the other energies, any one of which, according to the methodological principle we have stated, may be either contrary or contradictory to the others according as a positive or negative determination is made; i. e., the contradictory of mechanical, non-mechanical, includes, and can be converted into, as contraries, all the other energies, electrical, chemical, etc., and vital, too, if it exists, as can also non-electri-

¹ See Ostwald in various places.

cal, and so on in turn, so that *vitalism stands logically as a contrary obtained by converting the contradictories of each of the other energies.* However, this is in itself by no means a proof of the existence of a "vital force," but nevertheless these relations should be especially remembered in endeavoring to find any justification of the theory. From the above it is again seen that vitalism must also be subsumed under mechanism, as follows also from certain other admissions of the vitalists, as found stated by Bütschli, viz., that events in the organism are *quantitative* and take place in entire agreement with the law of *conservation*, and that the "vital force" is conditioned by and transformed out of and into the other energies.

The above seems to us to be the only possible logical relation consistent with methodological principles which a "vital force," providing it were first unquestionably proven to exist, could bear to mechanism on the one hand and to mechanics and the other specific sciences on the other. While, therefore, our argument has thus far been largely *ad hominem*, the important question remains to be decided *ad rem*, as to whether there is any justification for the acceptance of the existence of yet another distinct energy form, and to ask if it is not perhaps rather the result of an *invalid conclusion* from the impossibility of proving, e. g., "A" in detail on one side, i. e., from the "not-proven" or "unproven," to the "provenness" that "A" is *not* and so from this to the proven existence of the contrary "B" on the other.

The dispute centers therefore first about the possibility or impossibility of completely explaining (*begreifen*) the organism upon the basis of the at present generally accepted energy-forms, and so again demands a preliminary definition of terms. First, the meaning of the term *cause* is to be made clear, for even the vitalist considers his vital force to be causal. We find that our author (p. 10) distinguishes two kinds of causes (a) a "working" and (b) an occasioning (*auslösende*), besides (c) also conditions, for every event. To the first of these he makes the quantitative identity implied in the principle of conservation applicable, but he fails to realise that the other two, occasioning cause and conditions, are also ultimately reducible to the first, that they are also in turn only effects of "working" causes. Second, the concepts "describe" and "explain" are to be considered. Here our author (p. 14), reverting somewhat to Kirchhoff finds that "description" means to present (*aufzählen*) the spatial and temporal contiguity of things and events; that explanation also does this, but in addition thereto attempts to discover relations of causality, thereby becoming "causal description." But although this distinction is valid and our author has already expounded "causality" to us, he does not in any way suggest a practical criterion for the discovery of such relations, but, as so many scientists and philosophers before him have done, begs the entire question in the assertion, that when one event follows another with *logical and empirical necessity* then the first is the *cause* of the second: for the very essence of the question here is, how can *such a necessity* be brought to light? Nor is this criticism of Bütschli rendered invalid by his second definition of explanation

viz., that it is *subsumption*, for, as we indicated in our discussion of methodological principles, this is conditioned by the existence of *causal* relations, i. e., the first kind of explanation. Therefore a real practical criterion for detecting causal relations and so of explaining is not offered by Bütschli. That, however, there is such a criterion, viz., the quantitative identity existing between events which is implied in the fundamental attributes of mechanism or energetics, and that the discovery of its importance and its use by the physicists has been a chief factor in the development of modern science, this we would emphasise as bearing directly upon the question of the possibility of *explaining* the organism. Explanation is, we must conclude, the establishment of relations of cause and effect among phenomena, which relations are characterised and discovered by the presence of a quantitative identity and its implications, these relations and characteristics not being themselves explainable but only constitutable.

Can the organism, then, be explained? One thing is certain, and that is, that it cannot be unless the factors which condition or are identical with explanation elsewhere, viz., mechanism, its implications, and its subordinate energies and the *essential* characteristics of each, are also made use of here. But it must also be admitted that direct quantitative determinations cannot be made in the organism to the same extent at least that is possible elsewhere. This brings us in a way to the *crux of the matter*, to the question as to whether or not this impossibility of making as detailed and complete quantitative determinations of organic events as we can of inorganic prevents the subsumption of the organism under mechanism, and if it furnishes valid grounds for concluding to the existence of a "vital force." In answer to the first part of the query we may cite examples of the practice of those sciences which for the most part only describe things in their spatial and temporal contiguity and offer few "causal descriptions on account of the complexity of conditions, etc. Thus geology and mineralogy do not for such reasons in any way deny the validity of the principles of mechanism and the laws of the specific energies for their phenomena, but, on the contrary, recognising the impossibility of proving this by direct investigation for every detail of not only "prehistoric" events but also of present occurrences on account of their complexity and extent, accept the validity and make all possible use of both the general causal principles and the specific causal laws for all phenomena in their respective fields of research, and admit that everything takes place in full agreement with these and as a result of the coexistence of the at present accepted energy forms, of whose modes of action these specific laws are only expressions. It is in this way, for instance, that geology calls to her aid both chemistry and physics.

It is evident that here we again have to deal with a methodological principle which we may state as follows: that, as a result of that unity of all the sciences which comes from their being phylogenetically dependent on the same psychological (*Kausalitätstrieb*) (cf. Plato and Aristotle) and factually on the same logical conditions, viz., the assumption of the uniformity of an independent dynamical

principle in nature, and consequently in accordance with the principle of analogy (the ultimate method of all induction) that the laws and conclusions of any one science are extended in their application to every other science which deals, if only indirectly, with the phenomena dealt with directly by the first, and that these laws retain their validity in this extension until contradictions thereto appear as a result of independent investigations in this new and special field.

There would seem to be no reason then why biology, as one of the inductive sciences, should not proceed according to the same principle and therefore take the position that, in the first place, although the validity of the general and specific laws of the at present known energy forms cannot in every case at least be proven in every detail for the organism, nevertheless these laws hold good in every instance for these forms wherever found in the organism until this validity is done away with by independent investigations in this field of phenomena; and in the second place that these are the only energy *forms* which can legitimately be considered to be present in the organism until there is other evidence for new forms than that only of the impossibility of the above-mentioned *detailed* experimental proof. A complete *explanation*, i. e., deduction according to cause and effect, of the attributes of the organism from these of the energies not being possible, *description* must be appealed to, but the assumption of a "vital force" is not justifiable on this ground alone, though the *possibility* of its existence is therefore not to be denied, for, to put it technically, from the "unprovenness" (incomplete proof) of "A" we cannot infer the "provenness" of the contradictory "non-A" and so the contrary "B," but only also the "*unprovenness*" of the "non-A." Nevertheless upon this form of a *false* inference, as was before suggested, rest practically all the arguments of the vitalist for his theory.

There may be however from another quarter more serious objections to the possibility of *explaining* the organism than those so far discussed, viz., our as yet incomplete knowledge of chemical and physical phenomena themselves. Is this fact in itself a valid reason for accepting the existence of our hackneyed vital force? In answer to the first suggestion it is self-evident that where explanation ends in the one case it must also end in the other, but that of itself does not prevent a reduction of all physiological events to mechanism as we *now* conceive it and in the way we have above expounded. It perhaps goes without saying that there is no such thing as an ultimate explanation, but only a relative which consists in reducing certain facts of experience to others that in turn cannot be further reduced. What these ultimate elements are is the point of dispute between the "mechanical theory of the universe" and energetics, the one holding that *all* events in nature are motion, the other that *some* such events are not of this kind; therein lies the absolute contradiction between the two. However in either case all explanation becomes, as Kirchhoff pointed out, ultimately only *description*, but before we get to this we have what we call *explanation*, so that our question is: must we not accept this for the organic world also? In answer to the second question above the

same reply as was previously made must be repeated. The possibility of new energy-forms being discovered always remains, but one cannot validly conclude from that possibility and from incompleteness of detailed knowledge to the actuality of a new energy (vital force). Rather only when, having demonstrated conclusively by a process of exclusion the impossibility of reducing organic phenomena to the at present known energies, i. e., having a definite disproof of this reduction, and so having assumed that a new form exists, this energy can be measured and its factors given, (as in heat energy temperature and specific heat) then alone shall we be fully justified in accepting its existence as proven. How openly the vitalist, however, sometimes begs the question is seen from assertions like Bunge's (Bütschli, p. 16) that all those partial phenomena of organisms which can be understood (*begriffen*) physico-chemically are really not life-phenomena, and like Cossman's, that even a body made artificially out of the same stuff as plants and of the same structure would nevertheless not be an organism.

To give a more detailed statement of such a method we find that Bütschli suggests an as exact and complete study as possible, first, of the physico-chemical character of those "stuffs" which form the material basis of the simplest organisms, and, second, of those finer structure and form phenomena in the inorganic field which occur under known conditions and yet most closely resemble organic phenomena. We should then by a process of exclusion, consisting in showing that only under these conditions and under no others can the organism have arisen and continued to exist, show the unity of the organic with the inorganic. Such a method he thinks would also show definitely to what energy categories organic phenomena belong, and would prove more fruitful than the study of the simplest elementary life phenomena of growth, metabolism, etc.

It is not to be supposed that the vitalist is wholly ignorant of this method, for he is not; on the other hand he holds that its application shows him that there remains something which cannot be explained thereby, viz., the *form* of the organism and also its outer and inner *organisation*, both of which he claims can be understood only teleologically. The justification of this claim is therefore to be questioned. Bütschli's answer thereto is, that certain organic forms in both relatively static and in dynamic cases are undeniably dependent on the same factors as are the inorganic equilibrium forms of liquids and solutions, and this is confirmed by the results of some of the most recent investigations, as, for example, in artificial parthenogenesis and the development of double embryos. "Forms" are not lacking in the inorganic realm, and it is one of the fundamental principles of mechanism that "*equilibrium*" is everywhere sought and therefore that all the at present known energies are at least "form-conditioning energies." A specific "form energy" is to be assumed only on the conditions above expounded as proving such assumptions, and these we find warrant perhaps the acceptance of such an energy; for since the form of a body does not change unless work is done upon it, i. e., except by the use and transformation of energy, we must accept the existence of a

"form-energy" as a result of the law of conservation. But again this energy is quite as universally characteristic of the inorganic as the organic and cannot therefore distinguish one from the other or be the vital-form-energy which the vitalist is seeking. Nor can we see that Bütschli's above reply is incompatible with his subsequent statement "that the complex organic form arises in a manner which is without analogy in the inorganic realm, i. e., it develops," or that this places him in the ranks of the vitalists, as Renike has claimed. For it is certain that a "peculiarity" implies necessarily "something without (complete) analogy"; in the case under discussion the "forms of the phenomena of development" are in some respects certainly unlike "inorganic" forms; so that the "peculiarity" becomes a species-building characteristic. It might be as well one of the many differentia of inorganic bodies, for they also have peculiarities due to varying and different energy-complexes, but this does not prevent our discovering similarities, or analogies if one will, and subsuming them under the general principles of energy. "Without analogy" therefore does not mean without any but only "without *complete* analogy," and so implies a certain unity or similarity which shall be the very basis of the subsumption we are seeking. One must recognise that it is impossible to do away with the real peculiarities of anything, for these are facts, but we can, letting these stand, ask whether they are not the result of the coexistence of the energies we now have and perfectly compatible with mechanism in its present extension of meaning. It seems to us therefore that the vitalist, in concluding from the application of the methods we have just above presented that there is a vital force, does so because he has not really carried these methods to the limit of their valid application.

The same methodological position applies also to the question of organisation. (Cf. Bütschli, p. 72). Both organic and inorganic are organised, each individual in each realm in a way peculiar to itself, but the *fact of organisation* is at least common, and may consequently be in both cases *dependent on the same ultimate factors*. Bütschli finds that two types of organisation are distinguished by biologists, viz., a "maschinelle" (machine) and a chemical. The first of these is a concept which is derived primarily by the consideration of and abstraction from the parts of a machine and then applied by analogy to the highly complex and also simpler organisms. The difference here is at best one of degree only, and (p. 73) is ultimately dependent (in part) on a different chemical organisation; for that certain characteristics of inorganic bodies are so dependent is universally proved and accepted; viz., color, transparency, polarisation, cleavage, form of crystallisation, etc.: in the organic some if not all of these are present and therefore in agreement with the principles we have stated are to be considered as likewise so dependent. But for the organism there has been claimed in addition to these also a peculiar *structural* organisation of the "*ultimate vital elements*," such as "plasomes" (Wiesner), "biophores" (Weismann), "pangenes" (de Vries), in the assumption of which we find only question-begging epithets and a circumvention of the prob-

lem ; for that which is even put in question, viz., the existence of a vital force, is assumed without proof in these names.

It is nevertheless doubtless correct that the individual characteristics of the organism are dependent upon the "maschinelle" structure of the cell in so far as this is a complex of nucleus, centrosomes, cytoplasm, etc. (cf. Bütschli, p. 76) ; yet so are the characteristics of a galvanic cell similarly dependent upon its various parts, but this does not in itself mean the presence of differentia which are not reducible to our present energies. Likewise the question must be raised in the case of the organic cell as to what the ultimate nature of the nucleus, centrosomes, or plasomes, biophores, etc., is. To stop with them as *vital* is to beg the question. Admitting the existence of such units and the fact of their *chemical* organisation, this latter, though it be peculiar to itself in the same way as is every chemical compound in its structural formula, is to be conceived of only as in agreement with chemical principles and therefore with mechanism (energy). Such a "peculiar" (i. e., individual) chemical organisation together with the other energies necessarily coexisting with it (form, volume, heat, electrical, and perhaps osmotic) (cf. Ostwald), therefore conditions all the external manifestations and relations of the organism in a way quite analogous to "peculiar" inorganic instances. Here again we are arguing by analogy, but only such analogy, i. e., "similarity in diversity" or "identity in difference," as lies at the basis of all reasoning in the inductive sciences, as we have before pointed out. For example in chemistry, every structural formula is in some respects different from every other and so peculiar to itself ; by *analogy* it is accepted as valid for all molecules (groups of) manifesting the same characteristics as those bodies from the study of which it is obtained ; and by *analogy*, i. e., because of the similarity it bears to other formulæ in the matter of valence, etc., it is brought under the same *general* principles of chemistry and mechanism as are other structural formulæ. Biology must use the same method of procedure, and doing so and letting the peculiarities of the organism as a whole stand, but demonstrating the similarity of each one of these to those found in the inorganic world, ultimately show if possible that the at present known energy-forms suffice to account for the organism, and if not, in just what respect the insufficiency consists. Certainly neither the form nor the organisation can be held at present to form such an exception.

Lotze admitted that an accidental (*zufällig*) origin of the organic from the inorganic was conceivable for the simplest though not for the higher organisms, from which he implied, making "purposeful" identical in meaning with the contradictory of accidental, i. e., non-accidental, that there is in the higher forms at least a "force" which accounts for their purposefulness. Bütschli himself holds that the direct origin of organic forms out of inorganic, which forms should be capable of further development, is thinkable, although these forms would not be identical with the simplest forms which we know to-day ; such an origin however does away with a force or energy distinctly vital. Bütschli, to answer Lotze, recognises the neces-

sity of first establishing the meaning of the term "accident." He considers correctly, we think, that this concept does not exclude causality and regularity, but that it means an event which cannot be predicted or whose exact connection with other events cannot be shown on account of the complexity of conditions, etc.; i. e., notwithstanding incomplete knowledge and the absence of definite measurements, causality and the other principles of mechanism are still looked upon as holding good for these events. The inorganic world is therefore both accidental and non-accidental, and causal, and whatever the origin of the organic world may be, either accidental or non-accidental, in neither case is anything implied either for or against the existence of a vital force, for this latter would in any case be causal, etc. Consequently to think to support its assumption by identifying *non-accidental* with purpose is to make use of a manifestly invalid inference. For in the first place the *possibility of prediction* with which Lotze would be *obliged* to identify it is quite the opposite of that which is usually accepted to indicate purpose, and in the second this latter concept is used without first ascertaining its exact meaning, and if it is not really quite as compatible with accidental as with non-accidental and in any case with causality.

Admitting a purely physico-chemical origin for the simplest organisms, this explanation would, from the facts of organic continuity and development, apply also to the higher organisms and the processes of reproduction and development upon which their evolution is dependent, even though these processes are without *complete* analogy in the inorganic realm. Yet it is because of the seemingly extraordinarily purposeful and complex nature of at least these higher organisms that a metaphysical or teleological principle has been assumed and its function ascribed to a vital principle, a *Zielstrebigkeit*, a *Bildungstrieb*, etc. (cf. Bütschli, p. 29). Thus the step from purpose to vital force is made, which step would be valid only providing the presence of purpose were really proven to be a universal characteristic of the organism, this purpose could not be explained on the basis of our present energy-categories. The criticism which we find in Bütschli on this point is in general excellent, although in certain details open to objection. He finds, first, that the idea of purpose (teleology) is primarily derived from certain of our own psychical states (p. 29) and, second, that it has only a psychological and subjective but no universal objective validity. "End" is the general concept of something willed and implies the choice of, if possible, suitable, though sometimes of what proves to be unsuitable means for its realisation. The act is said to be purposeful especially when the desired end is attained, otherwise not. Accordingly the consciousness of the end or motive seems to be a psychical ground or cause for the purposeful act. Consciousness, therefore, and its correlate, a highly developed nervous system, seems to be a condition *sine qua non* for such acts (p. 29), for in order to be able to judge an act, an event (*Geschehen*) as purposeful, the *consciousness of an end* is the primary essential, for the attainment of which end the act is a means. In the inorganic realm, therefore, the assignment of ends is entirely arbitrary and

unjustifiable, for here the essential condition, consciousness, is absent, and the only assignable purpose for an event, if one will insist on using the term, is that it should happen. This necessity of the presence of consciousness for purposeful action even in the physical (inorganic) world has usually been recognised by all the philosophical writers on the subject, but they, as we also find some biologists doing nowadays, have also always attempted to evade the difficulties inherent in such an attempt by a logomachy; they have made such a *consciousness unconscious* in its nature, thereon constructing a *contradictio in adjecto*; nor have they denied its compatibility with mechanism.

The conclusion from this is then that the concept of purpose cannot have a meaning for the organism in its entirety, for certainly not every part of this has a conscious side; the most one can do is to say that its end is that it should persist and not die, at least until it has reproduced itself. The same might be said in part of a planet system, where, however, it is evident that any so-called "final cause" is identical with efficient causes, and therefore in a way superfluous, having only a subjective but no objective basis.

"Purpose" may seem to be more evident, however, in the "services" which a single organ performs for the entire organism, but here as elsewhere the assertion of purposefulness is a conclusion reached by assuming the existence of something analogous to the conditions for our own so-called purposeful acts, where really no basis for such analogy exists. It seems, therefore, that the presence of "purpose" is certainly not a universal characteristic of the organic realm, and that it consequently cannot be used in support of or identified with the long-looked-for vital force, which must at least be coexistent with the entire range of the organic.

On the other hand, to attempt to show that purpose is contradictory to mechanism is impossible for the very reason that our analysis and criticism of the former concept assumes the compatibility of the two as necessary; for our own "purposeful" acts, being conscious, depend, if we accept the theory of psychophysical parallelism, upon purely *mechanistic* (physiological) factors, a position which would not be altered even if the existence of a "vital force" should be proven on other grounds. If one and the same act is therefore both purposive and mechanistic, these can be only two different points of view. The former is, like the concept of the beautiful, a purely subjective, incomplete standpoint, oftentimes invalidly identified with indeterminism; the latter, that of mechanism, is an objective, ontological, explanatory, epistemological category, an ultimate and universal principle of all knowledge of nature, as we have previously indicated. They are two distinct principles of classification whose application does not necessarily lead to contradiction, any more than would weight and color if used as principles for classifying objects. This view of the matter is taken by the biologists themselves, e. g., Pflüger, who inculcated it in his *teleologisches Causalgesetz*, in which both purpose and mechanism are implicit, and Bunge, who according to Bütschli, admits that everything in the

organism, except the psychical, is "mechanistisch." Bunge, however, is a vitalist in a peculiar sense, as is seen from his statement that "the essence of vitalism consists in starting from the inner world," "the known," and that "in activity lies the secret of the organism," in which statements he identifies the vital force with consciousness, which should account for the purposefulness considered to be present. To be consequent, then, Bunge would be obliged to make consciousness co-existent with life and so swallow the "unliquid draught" of unconscious consciousness. In Reinke we meet an interesting modification of the argument for a "peculiar something" in the organism. (Cf. Bütschli, p. 103.) According to this author's theory of "dominanten," the distinguishing characteristic of the organism is a *Maschinenstruktur*; in a machine there are *Kräfte* which link the energies there present together and direct them to a certain end; these forces are the expression of the intelligence which was necessary in making the machine and can be interpreted only as unconscious intelligence (Reinke, '99, p. 113), i. e., conscious intelligence in the maker becomes transformed into unconscious in the machine. Such "dominanten" in the organism therefore should direct its phenomena and distinguish it from all inorganic nature that is not applied by man in his engineering products. In this theory we again meet the view that *purpose* demands intelligence of some kind, but here it is supposed to "link" and to "dominate"; but on the other hand, the doctrine of the *transference* of the intelligence making the machine to the machine itself is something quite new, and, we think, invalid. It implies a "conservation" or transformation of consciousness, which in a way contradicts the dualism upon which the theory rests principally, for *conservation* means *correlation* among different energies, which on the psychical side is impossible if dualism is true, and *vice versa*. Reinke's theory contains therefore a certain *contradictio eo ipso*.

At the conclusion of our inquiry in which we have considered, we believe, all the typical arguments for a "vital force," the following summary of the status of the problem seems to be justified. The strife between the two views of vitalism and of "non-vitalism," i. e., mechanism in its present extent of meaning, will probably continue until the time is reached when every detail of life phenomena is known and can be measured and predicted. For in the first place, while there is yet such a lack of knowledge of detail, there remains always the possibility of new energies being discovered, and the vitalist overlooks the fact that even if they were they could not contradict or be contrary to mechanism, but only to mechanical (kinetic) and the other energies. This results from the principle that only coördinates but not subordinates can exist in either of these relations. This being so, the possibility of passing by conversion of the contradictory of each one of the energies, non-kinetic, non-chemical, etc., to "*vital*" as the *contrary* always exists. This possibility is in itself, however, not a proof of vitalism, but indicates only the relations which would really exist were proof from an independent source offered and at hand. But the typical vitalist uses it, perhaps unconsciously, in concluding (inval-

idly) from the lack of complete proof that the organism is made up only of our at present known energies, i. e., from "A" to the contradictory proposition "non-A," that the organism is *not* so made up, as proven, and then by concluding by conversion of "non-A" to "B," the contrary, that a vital force exists. This reasoning is *invalid* for the reason that from the *unprovenness* of "A" *only the unprovenness* and not the provenness of the contradictory "non-A" results, e. g., if it is not (un)proven that two lines are *equal*, their inequality also remains unproven; on the other hand, if the supposition of their equality were *disproven*, then their inequality would necessarily follow. So likewise if the assumption that the organism is a complex of only those energies which we now accept were definitely *disproven*, then, by virtue of the same relations of contradiction, we would all have to accept the existence of a "vital force," although we would perhaps know nothing *about* this and have no *confirmation* of its existence until its factors, etc., were discovered. But not one of the factors considered by the vitalist to furnish such a disproof because of their being supposedly irreducible to our energy categories has stood the test, for it has been possible to show by that principle of identity in difference or of analogy which underlies all inductive method that these factors are so reducible. On the other hand, that there is *confirmation* of the vitalist's claim, no one would venture to assert. It is then the use of the principles of the contrary and the contradictory and based upon this the *invalid* inference from the incompletely proven, i. e., the unproven, to the provenness of the contradictory and then, by conversion, of the contrary, that *characterises*, we believe, *all the arguments for a vital force*. This reverses the direction of the valid use of the principles of classification we have expounded, the correct practical use being first to confirm the existence of a vital force and then to place it in its proper position in the classification.

However, we find that in the absence of a detailed proof and explanation of the organism as made up of our at present known and definitely confirmed energies certain methodological principles having to do with the range of validity of a law compel us to accept such a dependence for the organism. From this standpoint, then, the organism is to be considered as a peculiar complex of energies, all of which are found elsewhere in various coexistences and relations to each other and therefore conditioning various peculiarities, but nowhere else do they present the same peculiarities as does this peculiar complex, the organism, present. Chemical, electrical, and osmotic changes, surface tension, movement, etc., are all found elsewhere, but only all together in the organism. Equilibrium is here always sought and gained, causes becoming effects with no loss of energy and in the shortest time, i. e., the organism is a mechanism. Vitalism at present, then, remains without justification, and its assumption can be the result only of the ignoring of methodological principles and consequently of invalid reasoning.

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